TITLES AND ABSTRACTS
"GEOLOGIE UND BAUWESEN"
(GEOLOGY AND CIVIL ENGINEERING)
1949 to 1962

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I. INTRODUCTION

PROFESSOR STINI'S ENGINEERING GEOLOGY

It can safely be asserted that Professor Terzaghi founded the classic soil mechanics with the publication of his book "Erbaumechanik" in 1925. At about the same time, Professor J. Stini of Wien, Austria, also originated a unique approach to engineering geology, which since has developed in a distinctly different fashion as compared to conventional geology applied to technological problems.

From the very beginning Stini's engineering geology emphasized the importance of the structure of rock masses, as given by its plane-fabrics features, such as jointing, bedding, and schistosity. Stini's work on statistical surveys of geological discontinuities greatly contributed toward techniques of determining and evaluating the anistropy of rock masses.

Stini's concepts gave birth to "geomechanics" (or rock mechanics as generally designated in English-speaking countries) as developed and practiced in the Central European Alpine countries since the 1920's. Professor Stini actively participated in this development until his death in 1957. Since then, Dr. L. Müller, of Salzburg, Austria, has provided this group with a leadership that is conscious of the need for further methodical evolution. The "Salzburg School of Rock Mechanics" emerged from this more recent development. In this endeavor Dr. Müller has actively been supported by the late Professor L. Föppl, F. Pacher, and others.

This development of geomechanics and rock mechanics, covering about four decades, ultimately resulted in initiation of the International Society of Rock Mechanics by Dr. Müller.

"GEOLOGIE UND BAUWESEN"

The most important work of Professor Stini is unfortunately not presented in his books. His book, "Technische Geologie," published in 1925, does not, in his own opinion, represent modern engineering geology. True engineering geology, as advocated by Stini's Austrian School, is much better documented in his three-hundred odd papers than in his books.

A considerable number of Stini's papers have been published in "Geologie und Bauwesen" (Geology and Civil Engineering) which was founded by him in 1929. The principal objective of this periodical originally was to further the relationship between civil engineering and geology. With increasing progress this mutual, beneficial collaboration expanded to include engineering mechanics, geophysics, mining engineering, application of engineering geology to biology (termed "engineering biology" in European usage), and others.

In May 1963, in connection with forming of the International Society of Rock Mechanics, the periodical was renamed Felsmechanik und Ingenieurgeologie - Rock Mechanics and Engineering Geology - Journal of the International Society of Rock Mechanics. Thus, the new name goes hand-in-hand with an increased internationalization of its contents.

THE LANGUAGE BARRIER

The work published by Stini and Müller, and their disciples, represents a vast treasure of concepts, ideas, methods, and experiences, supported by case histories, in the fields of engineering geology, rock mechanics, and geotechnical engineering. All of this, because it is almost exclusively published in German, remained relatively unknown in the English-speaking world.

The compiler of the present titles and abstracts attempted earlier to summarize the concepts of the "Salzburg School of Rock

Mechanics in a paper in the English language."[*] The interest in the particular subject, expressed in the discussion and request for more information, suggested that additional effort might well be justified to overcome the language barrier and to disseminate some of the information contained in "Geologie und Bauwesen" in the English language.

PRESENT COVERAGE

The titles and abstracts as given here represent an attempt only to cover the most recent publications.

Volumes 16 (First Postwar) to 23 (1946 to 1957)

For this period, only the titles, original and translated, and authors of all 135 papers contained in "Geologie und Bauwesen" are included.

Volumes 24 to 28 (1958 to 1962)

This period concludes the publication of the original "Geologie und Bauwesen." Of the 90 papers published, short abstracts are given in addition to the titles and authors as indicated above.

The present collection was discontinued with the issuance of the renamed version of the publication in May 1963. Commencing at that time, each edition of the new journal contains English-language abstracts for all papers.

LIMITATIONS

It is well realized that the present coverage omits, or touches too lightly, many important contributions, particularly a considerable number of earlier papers by Stini and Müller. It is hoped that this series of titles and abstracts can be completed at a later date.

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[*]"An Approach to Rock Mechanics," K. W. John, Proc. of Amer. Soc. of Amer. Soc. Civil Engrs., Vol. 88, No. SM4, August 1962.

CLASSIFICATION

All entries, titles, and titles and abstracts were listed under one of the following subject groups. Although in many cases such a rigid classification is difficult to achieve, it is believed that it generally aids in reviewing the material presented in "Geologie und Bauwesen."

1. Engineering Geology
2. Geohydrology and Hydrology } Applied Geology

3. Engineering Mechanics
4. Rock Mechanics
5. Testing and Test Results
6. Tunnels and Underground Excavations } Rock Mechanics
7. Dam and Rock Abutments
8. Slopes and Landslides
9. Rock Bolting and Rock Anchors

10. Soil Mechanics
11. Geophysics } Related Subjects

12. Miscellaneous Titles

Within the subject headings (numbers), titles and abstracts are listed in chronological sequence. The resulting index numbers are used in Section III - AUTHORS' INDEX. Unless indicated to the contrary, the original articles appeared in the German language.

II. TITLES AND ABSTRACTS

1. ENGINEERING GEOLOGY

1.01 Are Dirt Roads Feasible in the Hungarian Lowland, Considering the Geological and Hydrological Conditions? (Kann die Erd-strasse im Hinblick auf die geologisch-hydrologischen Grundlagen als die Bauweise für die Ungarische Tiefebene angesehen werden?)

L. Hauser   Vol. 16, No. 2, 1947, pp. 49 - 63

1.02 Suggestions for an Engineering Geological River Map (Anregungen zu einer flussbaugeologischen Karte)

K. Bistritschan   Vol. 16, No. 2, 1947, pp. 64 - 64

1.03 Houskeeping, also in Engineering Geology (Haushalten, auch in der Ingenieurgeologie)

G. Beurle   Vol. 16, No. 2, 1947, pp. 76 - 77

1.04 On the Knowledge of the Deep Canyons (Zur Kenntnis der Tiefenrinnen)

J. Stini   Vol. 16, Nos. 3/4, 1948, pp. 96 - 105

1.05 Hydrological and Engineering Geological Observations at the French Atlantic Coast (Hydrologische und baugeologische Beo-bachtungen an der französischen Atlantikküste)

K. Bistritschan   Vol. 17, No. 4, 1950, pp. 109 - 119

1.06 On the Occurrence of Building Stones in the Upper and Lower Pinz Provinz (Über die Bausteinvorkommen des Ober und Unterpinzgaues)

A. Haiden   Vol. 17, No. 4, 1950, pp. 126 - 142

1.30 A Geotechnical Map of the City of Göttingen (Eine geologische Baugrundkarte der Stadt Göttingen)

M P. Gwinner   Vol. 22, No. 1, 1956, pp. 49 - 53

1.31 Remarks on Engineering Geological Evaluation of Borings (Bemerkungen zur baugeologischen Untersuchung von Bohrungen)

H. Häusler   Vol. 22, No. 1, 1956, pp. 61 - 65

1.32 Near East UNESCO Symposium on Applied Geology in Ankara, Turkey (Nahost-UNESCO-Symposion für Angewandte Geologie in Ankara)

K. Bistritschan   Vol. 22, No. 2, 1956, pp. 130 - 134

1.33 Core Drilling in Civil Engineering Explorations (Die Kernbohrung als Schürfbohrung im Bauwesen)

H. Seelmeier   Vol. 22, No. 2, 1956, pp. 135 - 140

1.34 Engineering Geological Observations at the Sariyar Power Plant in Turkey (Baugeologische Beobachtungen beim Kraftwerk Sariyar-Türkei)

K. Bistritschan   Vol. 22, No. 3, 1956, pp. 221 - 223

1.35 Engineering Geological Reports on Tunnels (Tunnelbaugeologische Gutachten)

E. E. Hensolt   Vol. 23, No. 3, 1957, pp. 139 - 160

1.36 Geological Survey and Prediction During Construction of Hydro-power Plant Prutz-Imst in Tyrol (Geologische Aufnahme und Voraussage beim Kraftwerksbau Prutz-Imst der TIWAG (Tirol))

The 7.7-mile (12.3 km) long pressure tunnel of the Hydro-power Plant Prutz-Imst at the Inn River, Austria, was completed in 1956. The results of the engineering geological exploration, which were based on superficial outcrops only, are compared with the actual findings during construction. The tunnel penetrated quartz phyllite and phyllite gneiss

with complex rock structures. The overburden ranged up to
3300 ft (1000 m) in depth. The difficulties of extrapo-
lating geological data from surface observations to the
tunnel location are discussed. Generally good correlation
was found during construction. Details on the rock struc-
ture are given. The advantage of using stereo maps for
evaluation of geological features is stressed. The penstock
and the underground powerhouse, 162 by 83 ft (50 by 25 m)
in plan and 60 ft (18 m) high, were located in jointed lime-
stones and dolomites. The excavation was orientated so that
the geostatical influence of the predominant joints was
minimized. The metamorphic rocks proved highly impermeable.
The limestone at the powerhouse location was highly permeable,
resulting in up to 37 GPS (140 1/sec) flow at individual
locations.

O. Schmidegg   Vol. 24, No. 1, 1958, pp. 22 - 29

1.37 Are Engineering Geological Surveys to Include a Detailed Inves-

      tigation of the Water Contained in Joints of In-situ Rock Masses?

      (Soll die baugeologische Geländeaufnahme auch eine eingehende

      Untersuchung der Kluftwasserverhältnisse im Felsgebirge ein-

      schliessen?)

      Any engineering geological investigation of underground struc-
      tures of some importance should include a careful study of the
      ground water conditions by means of borings. Knowledge of
      the position of the phreatic line of the water in joints and
      faults of the rock mass is important for design and construc-
      tion of pressure tunnels, dams and their reservoirs, and
      remedial measures for unstable slopes. The point of the paper
      is supported by numerous outlines of case histories.

      J. Stini   Vol. 24, No. 1, 1958, pp. 31 - 36

1.38 Utilization of New Type of Spatial Model in Applied Geology

      (Über die Anwendung eines neuartigen räumlichen Modelles in der

      praktischen Geologie)

      Spatial models, which illustrate the inhomogeneities and
      anisotropies of rock masses, are utilized for design of dams,
      large underground openings, and mine workings. A model
      showing contour lines and geological features by a system
      of wires bent accordingly is preferred over a model utilizing
      continuous horizontal plates, because of the difficulties
      in adjusting to new findings. The model of a dam site with
      the dam in place allows convenient observation of the change

in relation between predominant geological features and
the direction of the dam thrust as the structure is rotated
or otherwise modified.

A. Fuchs   Vol. 24, No. 2, 1958, pp. 118 - 120

1.39 The Pressure Tunnel of the Hydropower Plant Altenmarkt at the

Enns River (Der Triebwasserstollen des Ennskraftwerkes Alten-

markt)

Several alternate alignments of a pressure tunnel, approxi-
mately one mile long, to be constructed in Austria, were
studied in order to avoid unfavorable geological conditions.
Using his extensive knowledge of the region and judgment,
J. Stini proposed an alignment which was considerably longer
than the direct route, but which probably would not penetrate
critical zones composed of slate with gypsum. Subsequent
detailed investigations confirmed the advantages of the align-
ment as selected in the preliminary investigation.

E. Fischer   Vol. 24, No. 3/4, 1959, pp. 141 - 146.

1.40 Possibilities and Limitations of Geological Predictions, Dis-

cussed Using the Example of the Loibl Tunnel (Möglichkeiten

und Grenzen der geologischen Voraussage, erörtert am Beispiel

des Loibltunnels)

In southeastern Austria a highway tunnel, approximately one
mile long (1.6 km), was to be driven through highly faulted
rock masses of the Triassic period. Comprehensive geological
explorations provided important information for the design
engineers. The selection of the most favorable tunnel align-
ment, including the location of the tunnel entrances, was
based upon geological surface observations. Findings during
construction proved the geological predictions to be correct,
except for a 370-ft (110 m) zone where less stable rock was
encountered. In this zone the geological conditions were too
complex to be extrapolated from surface surveys only.

F. Kahler   Vol. 24, No. 3/4, 1959, pp. 165 - 170

1.41 Weathering of Rock (Rahmenverwitterung)

The type of grain bond of rocks, either indirect bond in sandstones or direct bond such as in granite or marble, determines the mechanics of weathering. The scaling of plane surfaces of building stones often commences at the center and progresses to the edges. This effect is believed to be due to more rapid drying near the edges of the surface. The center remains moist longer, which initiates the weathering effect. Some geological analogies to this process are given. Numerous photos illustrate the exfoliation of different types of rock due to weathering.

A. Kieslinger   Vol. 24, No. 3/4, 1959, pp. 171 - 186

1.42 Significance of Glacial Formations of the Alps for the Design of Pumping-Storage Plants, Presented Using the Hydropower Plant Weissach, Algau (Die Bedeutung der alpinen eiszeitlichen Bildungen für die Planung von Speicher-Kraftwerken, dargestellt am Weissach-Kraftwerk im Allgäu)

At the site of the proposed arch dam, a hydropower plant in southern Germany, molasse rock was encountered at one abutment and till at the other, indicating an epigenetic valley. When resistivity measurements did not provide definite results, five core borings were drilled which disclosed the considerable depth and horizontal extent of the moraine deposit at one abutment. The proposed dam had to be modified to an earthfill dam utilizing the moraine material. The pressure tunnel, approximately three miles (5 km) long, is to penetrate different types of molasse material. The proposed alignment was lowered by 133 ft (40 m) in order to avoid a trench filled with lake deposits of rock flour. Geological conditions resulted in placing the penstock and the powerhouse underground instead of on the till and clayey materials on the surface. The original design concept, which was developed without thorough geological information, had to be modified essentially because of the adverse geological conditions found later.

J. Knauer   Vol. 24, No. 3/4, 1959, pp. 187 - 191

1.43 From the Working Day of an Engineering Geologist (Aus dem Alltag eines Baugeologen)

The author, a geologist by trade, has come to engineering geology through soil mechanics. His professional activity encompasses the entire field of geotechnics, foundation investigations in both soil and rock, subgrade design for

highways, tunnel design, and slope stability studies. Several examples illustrate particular geotechnical problems, some in considerable detail. Principal aspects of geotechnical consulting on a commercial basis in Switzerland are discussed briefly.

A. Von Moos   Vol. 24, No. 3/4, 1959, pp. 192 - 203

1.44 The Excess Temperature in the Thermal Adit (Pasel Adit) of

Badgastein/Böckstein, Its Propagation in the Rock Mass and

Its Origin (Die Überschusswärme im Thermalstollen (Pasel-Stollen)

von Badgastein/Böckstein, ihre Ausbreitung im Gebirge und ihre

Herkunft)

During construction of the "thermal adit," 1.5 miles long (2.4 km), with overburden ranging up to 3450 ft (1035 m), near Badgastein, Austria, temperatures of the rock mass were observed which could not be explained by the deep overburden. From the tunnel entrance the temperature gradually increased to 111°F at Station 1.0 mile (1.6 km). The temperature then decreased in spite of the further increase of the overburden depth, resulting in temperatures considerably higher than the theoretical temperatures as would be determined by the geothermal gradient. Uranium minerals were found in the rock masses; the air in the adit also proved to be highly radioactive. The general phenomenon was investigated in a comprehensive hydrogeological and geophysical study. The thermal source and the considerable influence of major joints on the temperature propagation were derived from the pattern of temperature distribution. It is concluded that in spite of the subject experience, the standard concept of predetermining the temperatures in drifts by means of geothermal gradient is adequate.

F. Scheminzky and
J. Stini   Vol. 24, No. 3/4, 1959, pp. 228 - 241

1.45 The Pressure Tunnel of the Hydropower Plant Hieflau at the Enns

River (Der Triebwasserstollen des Ennskraftwerkes Hieflau)

A detailed account of a carefully planned and executed engineering geological exploration and control of a 3.7-mile-long pressure tunnel in Styria, Austria, is given. The alignment of the tunnel is parallel to the slope of a mountain massif consisting of limestone with some dolomite. The conditions are generally favorable for construction. A detailed geological survey of the tunnel alignment was conducted during

construction. The results of this survey are presented in the paper. In the center portion of the tunnel, local overstressing of the rock after excavation was observed. This overstressing was due to the combination of considerable overburden height with unfavorable orientation of the principal jointing. The penetration of a buried channel, approximately 80 ft (25 m) wide and filled with gravel, proved to be somewhat difficult. Numerical data are given on construction processes, which are believed typical for European construction techniques.

H. Seelmeier   Vol. 24, No. 3/4, 1959, pp. 242 - 257

1.46 The Significance of Concepts of Historical Geology for Rock

Mechanics (Die Bedeutung der historischen Denkweise in der

Geologie für die Geomechanik)

In rock mechanics, the genetic concept of the geology is often neglected, although it could provide valuable technical information. The importance of the paleogeographical and paleoclimatic conditions for the petrofabrics of the rock material is stressed. The influence of tectonic processes on the technological properties of the in-situ rock is obvious. Morphological concepts also should be considered. In many phases of geotechnics, the relation between the structure of a rock mass and geological processes which cause them is not clearly recognized. The time factor in geological processes is very important.

K. H. Heitfeld   Vol. 25, No. 2/3, 1960, pp. 191 - 202

1.47 Geomorphology and Petrofabrics of Basalt (Formen und Strukturen

des Basaltes)

The history of the origin of tertiary basalt is not yet completely understood. The differentiation between origin by extrusion and origin by intrusion is not yet possible. Based on the author's observation of the eruption of the Kilauea Iki volcano on Hawaii in November, 1952, the different patterns and petrofabrics of basalts and their origin are analyzed. In conclusion, petrofabrics of both extrusion and intrusion materials are described in detail. The paper represents a detailed account of primarily geological interest.

E. Schenk   Vol. 26, No. 4, 1961, pp. 258 - 272

1.48 Mapping of In-situ Rock for Geotechnical Purposes (Die Kartierung von Festgesteinen für geotechnische Zwecke)

A method for classifying in-situ rock according to its geo-technical properties is given. The following features are considered: rock type, elasticity and deformability, reaction upon stress relief, homogeneity, compactness, properties in connection with the ground water, and excavation and crushing characteristics. Many examples of this classification system are given. Codes for degrees of bedding, jointing, and fault-ing are introduced. Color codes for different types of rock are also proposed.

A. Graupner   Vol. 26, No. 4, 1961, pp. 273 - 288

1.49 Engineering Geological Investigation at the Wag-Plateau (Bau-geologische Erkundungen auf der Waghochfläche)

The principal aspects of an engineering geological investiga-tion of the site of the upper reservoir of a pumped-storage hydropower plant in Styria, Austria, are given. Large-scale percolation tests in shafts served to determine the per-meability of the terrace materials. Since the sands and gravels of the higher terrace were not deemed satisfactory, the bottom of the reservoir was located in the silty and cemented gravel of the lower terrace. In addition, the geologic history of the site is outlined.

E. Fischer and G. Spaun Vol. 27, No. 2, 1961, pp. 37 - 44

1.50 The Statistical Significance of Data on Rock Structure in Applied Geology (Die statistische Bedeutung von Strukturdaten in der angewandten Geologie)

Knowledge of the petrofabrics of the rock substance and the structure of in-situ rock is important for other than pure research purposes. Particularly, data on the structure of rock masses are of great significance in engineering geologi-cal work. The development of research on fabrics is reviewed briefly; reference is made to Exner, W. Schmidt, and Sanders. The mathematical relation between the number of observations, the area of the equal-area projection, and the area of the unit area after Kamb are given. This relation should give previous investigations on petrofabrics and rock structures more statistical significance.

M. Kirchmayer   Vol. 28, No. 1, 1962, pp. 55 - 57

1.51 On the Necessity and Scope of Geological Investigations in Dam Construction (Über Notwendigkeit und Ausmass geologischer Untersuchungen im Talsperrenbau)

The scope of the explorations of dam sites within the slate ranges of the Rhine Valley has expanded during the past decades. Although detailed geological maps of the subject area were already available, geological investigations of the earlier hydropower projects consisted essentially of general geological reports only. Only since 1945 have comprehensive geotechnical investigations, based on borings, been performed at future dam sites. These explorations resulted in more definite information, particularly on the permeability of the dam foundations. Three examples of dam projects subject to earlier investigations illustrate some of the shortcomings of the more general geological approach based on outcrops only. In conclusion, the following methods of modern geotechnical explorations are reviewed: geophysics investigations, drilling methods, logging of bore holes, geochemical investigations, ground water observations, water pressure tests, and rock mechanics tests.

H. W. Koenig and
K. H. Heitfeld   Vol. 28, No. 1, 1962, pp. 63 - 76

2. GEOHYDROLOGY AND HYDROLOGY

2.01 The Flood Catastrophe in Salzburg in July 1946 (Die Salzburger Hochwasserkatastrophe Juli 1946)

K. Bistritschan   Vol. 16, No. 2, 1947, pp. 67 - 69

2.02 The Measurement of Water Temperature as a Means to Determine Relations Between Springs and Open Flows (Die Wasserwärmemessung als Hilfsmittel bei der Bestimmung von Zusammenhängen zwischen Quellen und offenen Gerinnen)

J. Stini   Vol. 16, No. 3/4, 1948, pp. 92 - 95

2.03 Investigations on Artesian Wells in the Styrian Basin, Considering Their Importance to the Tertiary Geology (Erhebungen über artesische Wasserbohrungen im steirischen Becken, unter Berücksichtigung ihrer Bedeutung für die Tertiargeologie)

A. W. Von Hermaden and
W. Ritter   Vol. 17, No. 2/3, 1949, pp. 33 - 96

2.04 Annotations on the Theory of Erosion (Einige Vorbemerkungen zur Theorie der Erosion)

G. Stratil-Sauer   Vol. 18, No. 1, 1950, pp. 30 - 43

2.05 On the Determination of the Permeability of Soil Masses by Means of Settling Tests (Einges über die Bestimmung der Bodendurchlässigkeit durch Absitzversuche)

T. Lipcik and
L. Müller   Vol. 18, No. 2, 1951, pp. 102 - 111

2.06 The Surface Blanket of Flood Deposits (Die Lesedecke)

G. Stratil-Sauer   Vol. 18, No. 3, 1951, pp. 123 - 142

2.14 Displacement of Rivers and Problems at the River Mouths
(Flussverdrängung und Mündungsprobleme)

J. Putzinger   Vol. 21, No. 1/2, 1954, pp. 51 - 60

2.15 Criteria of the Formation of Compensation Profiles (Kriterien
der Kompensationsprofilbildung)

J. Putzinger   Vol. 21, No. 1/2, 1954, pp. 61 - 67

2.16 On the Causes of Meandering of Rivers (Über die Ursachen des
Schlingerns der Flüsse)

J. Putzinger   Vol. 21, No. 3, 1955, pp. 97 - 109

2.17 Does the Variation in Yield of Springs in Limestone Terrain
Reflect the Quality of the Drinking Water? (Spiegeln die
Schüttungsschwankungen der Quellen im Kalkgebirge die Güte
des Trinkwassers wider?)

J. Stini   Vol. 22, No. 2, 1956, pp. 69 - 73

2.18 Geological Observations of the Flood Catastrophe in Styria in
August 1958 (Geologische Beobachtungen von der steirischen
Unwetterkatastrophe vom August 1958)

> Excessive rainfall, up to 16 inches (400 mm) in 24 hours,
> resulted in extensive flooding and erosion within the Styrian
> part of the Eastern Alps in Austria. A detailed account of
> observations is given. Erosion of overburden materials re-
> sulted in considerable deposition in most brooks. The effect
> of poor plant cover is discussed. Hundreds of local slope
> failures developed because of saturation of the overburden
> soils. Thin overburdens proved to be more critical than
> thick ones.

E. Clar   Vol. 24, No. 3/4, 1959, pp. 131 - 140

2.19 Leaching of Carbonic Rock (Auslaugung von Karbonatgesteinen)

> Three examples of the formation of solution channels and
> caverns in phyllitic and limestone formations in the Central
> Alps (Austria) are described. The leaching is attributed

to both flowing and stagnant water. Considerable construction difficulties both in support of arch dams and tunneling resulted from these cavities.

G. Horninger   Vol. 24, No. 3/4, 1959, pp. 159 - 164

2.20 Hydraulic Effects in Geodynamics

The paper presents a comprehensive treatise on the flow of surface water with related morphological processes. The dynamics of flowing water is reviewed. The equations of forces of fluids on particles are derived. River bed processes, such as turbulent flow and sediment transportation, are analyzed mathematically. Erosional and depositional processes forming slopes are illustrated by quantitative analysis. The mechanics of meandering and forming of deltas are discussed briefly. The existence of turbidity currents in oceans is discussed in the conclusion. The mathematical approach to subject problems is stressed throughout, which might also be of interest for practicing engineers and geologists who are searching for new approaches to problems related to surface flow of water. (Engl.)

A. E. Scheidegger   Vol. 25, No. 1, 1959, pp. 3 - 49

2.21 Technical Changes of Subsurface Conditions Might Result in Reduced Agricultural Yields (Technische Eingriffe in den Untergrund mit landwirtschaftlichen Mindererträgen im Gefolge)

Civil engineering and mining projects, and technical measures related to them, might result in changes in the ground water conditions which, in turn, might result in reduced agricultural yields. The influence of an open pit operation in West Germany on the adjoining agriculturally utilized land, underlain by sandy soils, was investigated. Tests disclosed the hydrogeological conditions of the region. Based upon the findings, the damage claims were disproved in this particular case of permeable soils where rainfall was the principal source of soil moisture.

G. Keller   Vol. 25, No. 4, 1960, pp. 248 - 255

2.22 Soils of the 'Hohen Tauern' and Their Hydrological Conditions (Böden in den Hohen Tauern und ihr Wasserhaushalt)

In connection with design and construction of the Kaprun hydropower project in Austria, a detailed analysis

was conducted of the influence of the anticipated change in ground water conditions in the soil of a sloping region and its hydrogeological conditions. A detailed account is given of location, climatic and geologic conditions, methods of investigation, soil sections, and soil mechanics and hydrological properties. The paper essentially presents data only; no definite conclusions to the particular problem are derived.

B. Ramsauer   Vol. 25, No. 4, 1960, pp. 268 - 298

3.   ENGINEERING MECHANICS

3.01   On the Application of Engineering Mechanics in Structural
        Geology (Über die Anwendung der technischen Mechanik in der
        tektonischen Geologie)

        H. Kastner   Vol. 20, No. 2, 1953, pp. 56 - 76

3.02   The Transition from Adhesive Friction to Sliding Friction
        (Der Übergang von der Haftreibung zur Gleitreibung)

        L. Föppl   Vol. 21, No. 4, 1955, pp. 145 - 148

3.03   Disturbance of the State of Stress by Open Joints Adjacent to
        a Pressure Tunnel (Störungen des Spannungszustandes in der
        Umgebung eines Druckstollens durch Spalten)

        L. Föppl   Vol. 23, No. 1, 1957, pp. 4 - 8

3.04   States of Elastic Stress in Bodies with Plane Boundaries
        (Elastische Spannungszustände in Körpern mit ebenen Schnitten)

        L. Föppl   Vol. 23, No. 1, 1957, pp. 9 - 11

3.05   Photoelastic Studies of Retaining Walls, Laterally Supported
        by Pre-Tensioned Rock Anchors (Spannungsoptische Untersuchungen
        an angehefteten Stützmauern mit vorgespannten Stützankern)

        G. Sonntag   Vol. 23, No. 1, 1957, pp. 12 - 18

3.06   The Stressing of Rock Masses Surrounding a Slot, Depending
        on Its Direction as Related to the Ground Surface (Die Beanspru-
        chung des Gebirges in der Umgebnung eines Schlitzes in Abhän-
        gigkeit seiner Richtung zur Erdoberfläche)

        G. Sonntag   Vol. 23, No. 1, 1957, p. 19

3.07 The Strain Energy as Criterion for the Stability of a
      Circular Tunnel (Die Formänderungsarbeit als Kriterium für
      die Standsicherheit eines Stollens von kreisförmigem
      Querschnitt)

      L. Föppl   Vol. 23, No. 2, 1957, pp. 64 - 65

3.08 Bending Stress in Tunnel Linings Based on Photoelastic Studies
      (Biegebeanspruchung in Tunnelröhren auf Grund spannungs-
      optischer Untersuchungen)

      G. Sonntag   Voi. 23, No. 2, 1957, pp. 79 - 81

3.09 Support of Foundation Loads of Bedding Planes that Dip Downhill
      (Aufnahme von Fundamentkräften in talwärts fallenden Gleit-
      schichten)

      G. Sonntag   Vol. 23, No. 2, 1957, pp. 99 - 102

3.10 The Soil Pressure Under a Loaded Continuous Footing (Der
      Bodendruck unter einem belasteten Fundamentbalken)

      A brief account is given of the stress distribution under
      continuous footings supported on an elastic medium. A for-
      mula for the stress distribution also is given. The theo-
      retical concept was qualitatively confirmed by photoelastic
      experiments.

      L. Föppl   Vol. 24, No. 1, 1958, pp. 2 - 3

3.11 Investigation of Stability of Tunnels by Microseismic Methods
      (Untersuchung der Standfestigkeit von Stollen nach der Methode
      der kleinen Schwingungen)

      The recognized fact that the stability of underground open-
      ings in competent rock decreases with increasing size of
      cross sections has not yet been proved physically. The
      stability of an infinite plate, with a circular hole punched
      in it and subjected to one-dimensional stresses, depends on
      the two states of radial and elliptic resonance of thin
      plates. Formulae for the stability criteria for both vibra-
      tion modes are derived. In both formulae the radius of the
      tunnel is related to the wave lengths. Elliptic vibrations

represent the most critical condition. It is concluded that this consideration represents proof of the decreasing stability of tunnels with increasing diameter.

L. Föppl   Vol. 24, No. 3/4, 1959, pp. 147 - 158

4.   ROCK MECHANICS

4.01 On the Differences of Geological and Technical Stressing
      (Von den Unterschieden geologischer und technischer Beanspru-
      chungen)

      L. Müller   Vol. 16, No. 3/4, 1948, pp. 106 - 161

4.02 The Technology of the Earth's Crust (Technologie der Erdkruste)

      L. Müller   Vol. 17, No. 4, 1950, pp. 97 - 108

4.03 The Survey of Joints and the Orientation of Arch Dams
      (Kluftmessungen und Talsperrenlage)

      R. Fill   Vol. 17, No. 4, 1950, pp. 114 - 125

4.04 The "Unit Rock Block" (Der Kluftkörper)

      L. Müller   Vol. 18, No. 1, 1950, pp. 52 - 60

4.05 Analysis of the Residual Stress in Rock Masses (Berechnung
      des Gebirgsdruckes in Fels)

      C. Torre   Vol. 18, No. 2, 1951, pp. 83 - 95

4.06 On the Degree of Loosening of Rocks (Über das Mass der Auflocker-
      ung von Gesteinen)

      L. Müller   Vol. 18, No. 2, 1951, pp. 96 - 101

4.07 Annotation on the Formation of Cracks in Moist Mudstones
      (Eine Notiz zur Rissbildung an feuchten Peliten)

      H. and E. Häusler   Vol. 18, No. 3, 1951, pp. 177 - 185

4.08 A Study Group for Rock Mechanics (Eine Arbeitsgemeinschaft für
      Geomechanik)

      L. Müller   Vol. 18, No. 4, 1951, pp. 247 - 252

4.16   The Technical Effects of the Anisotropy in Rock (Technische
       Auswirkung des Gesteinsanisotropie)

       L. Müller   Vol. 23, No. 1, 1957, pp. 1 - 3

4.17   Rock Mechanics Evaluation of Details of Rock Structure)
       (Geomechanische Auswertung gefügekundlicher Details)

         In-situ rock under stress behaves pseudo-plastically. It
         fails in a creeping manner following the direction of least
         resistance under a given state of stress. The failure
         patterns follow existing jointing in the rock mass. The
         terms of "residual bond" and "interlocking bond" of rock
         masses, and technical indices of the rock structure, are
         defined. The possibilities of analytical treatment are
         outlined. A brief account of rock mechanics exploration
         and analysis of geostatical problems connected with working
         in a coal stratum is given. An outline of requirements for
         engineering geological investigations completes the paper.
         The paper contains an interesting table describing strengths
         and deformability of different types of in-situ rock.

       L. Müller   Vol. 24, No. 1, 1958, pp. 4 - 21

4.18   Classification of In-situ Rock in Tunnel Construction
       (Gebirgsklassifizierung für den Stollenbau)

         During construction of a 7.7-mile (12.3 km) long pressure
         tunnel in Austria, a classification for the in-situ rock
         was used which considered the particular conditions of
         tunnel driving. The in-situ rock can be classified accord-
         ing to the type of support and anchoring necessary for
         temporary support. With the wide variety of temporary
         support techniques, this has become increasingly difficult.
         Consequently, a classification system was devised which
         utilizes the relation between the time the unsupported
         opening remains stable and its width. Openings more than
         13 ft (4 m) wide will remain stable in competent rock
         for many years. This time-span ratio decreases to five hours
         for five-ft (1.5 m) spans in friable rock masses and to ten
         seconds for six-inch (0.15 m) spans in unstable rock. The
         influence of the orientation of bedding, of the area of the
         cross section, and of the excavation and temporary support
         methods can be evaluated using similar time relationships.

       H. Lauffer   Vol. 24, No. 1, 1958, pp. 46 - 51

4.19 Residual Stresses and Stress Relief in Rock (Restspannungen und Entspannung im Gestein)

Numerous stress relief phenomena on surficial rocks, predominantly igneous rocks, are described. In some cases large-scale scaling of flanks of mountains can be observed; in other cases thin parallel plates pop off horizontal rock surfaces. The same phenomena can be observed in steep rock slopes which result in fissuration approximately parallel to the slope line. This parallelism is sometimes obscured by subsequent erosion changing the original geomorphological form. It is believed that rock is able to store residual stresses which are ultimately relieved by volume expansion towards free surfaces. The fissuration of surficial rock due to overstressing independent of actual jointing is utilized in quarry operations.

A. Kieslinger   Vol. 24, No. 2, 1958, pp. 95 - 112

4.20 Indices of the Rock Structure (Kennziffern des Flächengefüges)

The structure of in-situ rock can be technically evaluated employing statistical surveying methods. The indices of two- and three-dimensional extent of joints are defined. Their relations to field measurements and to each other are given. These two values can be determined for any set of joints; they are utilized to describe the general structure of in-situ rock. Together with the orientation of joints, these values serve to construct the unit rock block, which represents the individual rock units that theoretically compose a jointed rock mass. Data on the technical properties of joint surfaces complete the information provided by rock mechanics surveys of jointed rock masses.

F. Pacher   Vol. 24, No. 3/4, 1959, pp. 223 - 227

4.21 Rock and Geomechanics (Fels und Geomechanik)

The relationship between engineering geology and soil mechanics, particularly the necessity of close collaboration, is discussed. Soil mechanics is limited to grained soil; beyond these limits rock mechanics, as a division of geomechanics, should take over. Rock mechanics is believed to be essentially an engineering field, beyond the reach of many geologists. The importance of rock mechanics for and the acceptance by the mining industry is stressed. Rock mechanics analyses are to be supported by testing. A rock testing laboratory is desirable.

F. Kahler   Vol. 25, No. 2/3, 1960, pp. 89 - 94

4.22   Ten Years of In-situ Measurements of Rock Compression, Progress
and Practical Results (Dix ans de mesures de compression in-
terne des roches; progrès et resultats pratiques)

Electricité de France developed several methods for determin-
ing the state of stress in in-situ rock masses. Simplicity,
speed, and low costs were required from the construction
point of view. Different types of test arrangements based
on the stress relief technique are described. A new method
in which the compression is determined from friction between
steel plates of known properties is proposed. A vast amount
of in-situ tests resulted in improved knowledge of the stress
conditions in rock masses adjoining tunnels. Four case his-
tories of in-situ stress measurements in tunnels are given,
in which considerable numerical data are presented. (French)

J. Talobre   Vol. 25, No. 2/3, 1960, pp. 148 - 165

4.23   Do Rock Bursts Occur Periodically? (Gibt es eine Periodizität
der Gebirgsschläge?)

Previous investigators concluded that there is no periodicity
of rock bursts in mining. However, from statistical evalua-
tion of observation data of an East German mine a certain
relationship between the occurrence of rock bursts and the
tidal cycle can be derived. This tidal cycle influences
not only the ocean, but also the earth's crust. The direc-
tions of the vectors of tidal accelerations vary and are
believed to be a definite influence on stress-relieving
processes in the earth's crust. The paper presents hypo-
theses but no definite conclusions.

K. H. Höfer   Vol. 25, No. 2/3, 1960, pp. 166 - 175

4.24   Construction in Rock and Geomechanics (Gebirgsbau und Geomechanik)

Rock and soil mechanics are believed to be comparable in their
predominant interest in problems of civil engineering and
mining construction. Geomechanics covers a much wider field,
the mechanics of the entire earth's crust, solving tectonics
problems. Geomechanics could be considered to be a division
of geophysics. The determination of the dynamics of tectonic
processes based on rheology, rock structure, and mechanics
appears to be the principal problem. The influence of the
time factor is most important from a geological point of view.

E. Clar   Vol. 25, No. 2/3, 1960, pp. 186 - 190

4.25 Rock Mechanics in Civil Engineering and Mining Practice
(Die Geomechanik in der Praxis des Ingenieur- und Bergbaues)

The wide scope of rock mechanics as applied to civil engineering and mining projects is illustrated by a variety of examples. Anchored revetment walls provide an economical structural element in highway and railroad construction in mountainous countries. The knowledge in some problems related to design and construction of arch dams, particularly the effects of water contained in and flowing through jointed rock masses supporting dams, has been improved by the application of rock mechanics concepts. More information is available now on the state of stress in steep rock slopes and the mechanics of their failure. Construction of a large underground power station in faulted rock masses necessitated extensive rock anchoring. The application of rock mechanics to tectonic problems appears promising.

L. Müller   Vol. 25, No. 2/3, 1960, pp. 203 - 214

4.26 Rupture and Creep in the Terminology of Geology and Mechanics
(Brechen und Fliessen in der geologischen und mechanischen Terminologie)

A well defined terminology for the most essential processes of rock mechanics which can be understood by both engineers and geologists is urgently required. Abstracts from mostly European rock mechanics literature are used to present definitions being used or being proposed for specific problems, such as failure in rock, structure of rock mass (jointing, fissuration, faulting), and rheology of rock (deformation and creep in relation to time). The paper, which is intended to initiate a discussion, presents a very complete list of references to European publications on particular subjects.

L. Müller   Vol. 25, No. 2/3, 1960, pp. 218 - 227

4.27 On the Stress-Strain Mechanism in Rock Masses Adjoining Underground Openings (Über den Mechanismus der Bildung der sogenannten 'Trompeter's Zone')

In 1929 the "Trompeter's Zone" was defined as the zone adjoining a new underground opening in which stress relief has occurred. The validity of this concept has been discussed extensively, and modified by other researchers. In this paper three types of in-situ rock are discussed: elastic, pseudo-plastic, and plastic rock. (1) In elastic rock

subject to low stressing, a relaxation zone cannot exist.
If the stressing increases beyond the ultimate strength of
this rock mass, fractures develop within this overstressed
zone, resulting in stress redistribution and stress reduc-
tions near the opening. (2) In pseudo-plastic rock high
rates of loading may result in similar conditions. Slow
or even constant stressing results in local plastification,
with subsequent stress reduction. This process continues
within the rock mass until equilibrium is reached. (3)
The conditions for plastic rock are principally similar
to the pseudo-plastic case; however, they depend on the
planar structure of the rock. References to international
literature on this particular subject are given.

K. H. Höfer   Vol. 26, No. 1, 1960, pp. 2 - 13

4.28 On the Problem of the Frequency of Rock Bursts in Relation to

Geophysical Factors (Zur Frage der Häufigkeit der Gebirgs-

schläge in Abhängigkeit von den physikalischen Grössen)

In many mines, the frequency of rock bursts varies with the
seasons. In the deep ore mine of Pribran, Czechoslovakia,
rock bursts were recorded over a 47-year period. Rock bursts
occur most frequently in spring and fall seasons. Other
researchers found similar concentrations in particular
seasons. Certain relationships between occurrence and fre-
quency of rock bursts and the velocity of the earth's rota-
tion are found by means of the statistical comparison.

R. Kvapil   Vol. 26, No. 1, 1960, pp. 33 - 37

4.29 The Similarity Between the Icecap of the Jungfraujoch and the

Large Ice Sheets of Greenland and the Antarctica (Ein Parallele

zwischen der Eiskalotte Jungfraujoch und den grossen Eisschildern

der Arktis und Antarktis)

Displacements and deformations within and at the surface of
the 100-ft-thick icecap at the Jungfraujoch were measured
over a ten-year period. Time rates and deformation profiles,
deformation patterns within circular tunnels, the mechanics
of spalling, and the state of stress within the ice sheet
were studied and observed. The equation of flow of ice is
presented, which might relate the present observations with
the mechanics of the extensive ice sheets of Greenland and
Antarctica. The steady motion of these ice sheets in
equilibrium is considered to be a continuous creep due to
gravity only. The equation of the surface of the ice sheet

is given. Field measurements correlate well with the analytical results. This is a comprehensive paper with detailed observation data and includes numerous references on the subject.

R. Haefeli   Vol. 26, No. 4, 1961, pp. 191 - 213

4.30 On the Analysis of Rock Mechanics Problems Associated with

Forming of Magmatogenic Ore Deposits (Gebirgsmechanische

Probleme bei der Bildung magmatogener Ganglagerstätten)

Rock mechanics problems can be analyzed by two principal
methods. The first method begins with the forces applied and
derives the mechanical effects within the region. The second
method evaluates the phenomena observed in order to determine
the forces causing them. The first approach necessitates
simplifying assumptions on inhomogeneity and anisotropy of
the natural materials, the knowledge of the factor time, and
information on the history of the rock. The results of model
tests suffer particularly from the often extremely simplified
assumptions. The concept of deriving the cause from the re-
sults calls for the evaluation of a process from individual
states, which might not even contribute to the process of
interest. The latter approach gained considerable assistance
from the analytical method for evaluating observations on the
rock structure. Two examples of tectonic processes illustrate
the second approach.

A. Watznauer   Vol. 26, No. 4, 1961, pp. 214 - 217

4.31 On the Consideration of Time Relations in the Theory of the

Mechanical Behavior of Rock Masses (Zur Berücksichtigung der

Zeitabhängigkeit in der Theorie des mechanischen Verhaltens von

von Gesteinsmassen)

Rock mechanics analyses are impeded by inelasticity, anisotropy,
and jointing of the average in-situ rock. Two diametrically
opposite idealizing concepts are possible: (1) rock material
is an inelastic continuum to be analyzed by methods of mechanics
and thermodynamics, and (2) soil masses are discontinued, to be
dealt with by stochastic methods. Rock mechanics is to inter-
polate between these two possibilities. The stress-strain
relations within a solid in relation to time are described by
its "equation of state". The idealized solids are replaced by
mathematical models, of which the Nakamura solid well represents
viscoelastic, stress-relaxing rock masses. The equation of
state applies only for small deformations; however, conditions
for plastic deformation and failure also can be derived. The

different states of a stressed solid and the modes of failure
are given in relation to the principal stresses. The com-
prehensive paper includes mathematical derivations and ref-
erences to other papers on the same subject, particularly in
the Eastern hemisphere.

W. Buchheim   Vol. 26, No. 4, 1961, pp. 218 - 233

4.32 On the Terminology of Geomechanics (Zur Terminologie der Geo-
mechanik)

A precise terminology is more important in engineering geology
and geotechnics than in general geology. It must be under-
stood beyond any doubt by both geologists and engineers. Clear
definitions are particularly necessary to clarify the complexes
of structure (joints and faults) and failure of in-situ
rock. The problem of different meanings of similar terms
in different languages is far from solved.

K. H. Heitfeld   Vol. 26, No. 4, 1961, pp. 289 - 291

4.33 Relaxation Phenomena in the Excavation of the Rappbode Dam
(Entspannungserscheinungen in der Baugrube der Rappbodetalsperre
Harz)

A comparison of permeability data of the Graywacke foundation
rock of the Rappbode dam in East Germany, obtained prior and
after excavation, indicated that the permeability of the in-
situ rock increased with the removal of the surcharge. This
effect was particularly strong at the center of the valley and
negligible near the slopes. Thus, it cannot be attributed to
loosening by blasting. It is believed that the expansion is
due to stress relief. The process was found to be reversible.
It is concluded that any remedial methods such as grouting
should only be conducted after at least part of the structure
is applied as surcharge and the upheave due to excavation is
reversed.

F. Reuter   Vol. 27, No. 2, 1961, pp. 73 - 76

4.34 Remarkable Stress Phenomena in the Bleiberg-Kreuth Mine (Bemer-
kenswerte Gebirgs-Spannungserscheinungen im Bergbau Bleiberg-
Kreuth)

A series of rock bursts in highly mylonitized limestone in a
120-ft-deep shaft within a year's time resulted in stable

conditions in an Austrian lead mine. No bursts have been observed for the last seven years. In a part of another mine, which was being reworked, spalling from the roofs and walls of tunnels was observed. This spalling is believed due to overstressing caused by the reduction of pillar sizes and increased loads. Spalling occurred but without the common explosive effect of rock bursts and with only low velocity. Up to 60 spalls per day were observed within a zone with an approximate volume of one-million cubic yards. The phenomenon was not observed beyond this limited range. After installation of additional backfill material, rock spalling ceased and a new stable state of stress was obtained.

L. Kostelka   Vol. 27, No. 2, 1961, pp. 82 -88

4.35 Determination of the Strength Anisotropy of a Rock Body, which

is Intersected by Several Sets of Joints, by Means of Computer

(Ermittlung der Festigkeitsanisotropie eines Gesteinskörpers,

der von mehreren Kluftscharen durchzogen wird, mit elektronischem

Rechengerät)

In order to analyze the strength characteristics of partially jointed in-situ rock, prototypes were assumed, based upon previous work by L. Müller and F. Pacher. The jointing of the rock material within the mass is assumed to be distributed statistically; it is based upon the findings of a rock mechanics survey. Three types of failures are investigated; tensile failure and shear failure through rock substance, and shear failure in the direction of a set of joints. The "resistance quotient" is defined as the ratio of strength over stressing; it varies with the direction considered. A computer was programmed to determine this ratio for the different modes of failure, based upon input data on geometry of the rock structure. The paper presents only abbreviated mathematical derivations without discussion of the results.

A. Hereth and
A. Schombierski   Vol. 27, No. 3/4, 1962, pp. 126 - 128

4.36 On the Development of Joints Parallel to Surface, an Attempt

of a Rock Mechanics Interpretation (Über die Entstehung ober-

flächenparalleler Klüfte, Versuch einer geomechanischen Erklärung)

The observations of natural overstressing phenomena and those initiated by man, combined with stress measurements

near steeply sloping surfaces of rock banks, suggest a
similarity between the stress conditions adjacent to a
tunnel and those adjacent to a steep rock slope. The normal
stresses generally are considerably higher than could be
expected from the tangential stresses. Overstressing near
the surface results in spalling of rock slabs parallel to
the slope. The stress concentration recedes inward, re-
peating the spalling process. With increasing recession the
stresses decrease and develop only potential fissuration in
the rock mass. The importance of fissures parallel to the
slope line for the design of arch dams is stressed.

L. Müller   Vol. 27, No. 3/4, 1962, pp. 146 - 152

4.37 The Extent of Loosening of Rock Due to Blasting (Das Ausmass
      der Felsauflockerung bei Sprengarbeiten)

From the experiences of the excavation blasting for the weir of
the Ybbs-Persenbeug hydropower plant at the Danube River, Austria,
the following conclusions are derived: Blasting resulted in a
100% increase of the effective porosity. The loosening effect
generally extended to a depth of 7 ft (2 m); along distinct
fissures this value increased up to 17 ft (5 m). The increase
in permeability is very significant. Consequently, design
assumptions should be based on tests after excavation blasting.
The amount of settlement depends directly on the loosening
of the rock support, thus on the method of excavation. Data
on grouting work and permeability tests illustrating the con-
clusions of the paper are presented.

F. Makovec   Vol. 28, No. 1, 1962, pp. 58 - 62

5.   TESTING AND TEST RESULTS

5.01 The Bursting Effect of Water in Compression Tests on Moist
Materials (Die Sprengwirkung des Wassers beim Druckversuch an
wasserhaltigen Feststoffen)

> Wet concrete cubes subject to unidimensional compression,
> under exclusion of lateral restraint at loaded surfaces,
> generally fail by splitting into slabs parallel to com-
> pressive load. This splitting is a result of tensile over-
> stressing normal to direction of compression, which is
> believed due to the development of pore water pressure.
> The splitting occurs normal to the direction of the outward
> flow of pore water. The same mechanics apply to the bursting
> of saturated material due to frost action.

L. Föppl   Vol. 24, No. 1, 1958, pp. 52 - 55

5.02 Experimental Investigations of the Deformation Characteristics
of Rock Masses (Experimentielle Untersuchungen über die Charak-
teristika der Verformbarkeit der Felsen)

> Data on the deformability of in-situ rock masses and their
> characteristics, such as inelasticity and anisotropy, are
> important for the design of large dams. The deformation
> properties of in-situ rock can be influenced greatly by
> grouting. The deformability of in-situ rock can be deter-
> mined by local plate-load tests and pressure-chamber tests.
> The results of dynamic in-situ tests are often considered
> doubtful. Deformability of in-situ rock generally is con-
> siderably greater than that of small specimens. In Italy
> the behavior of dams founded on inhomogeneous, anisotropic
> rock masses was investigated successfully in model tests
> in which the principal faults and differences in deform-
> ability of the rock foundation were represented. The
> results of deformation tests, both in-situ and in the
> laboratory, are given.

G. Oberti   Vol. 25, No. 2/3, 1960, pp. 95 - 113

5.03 Apparatus for Determining the Deformability of In-situ Rock for
Design of Pressure Tunnels and Their Linings (Ein Gerät zur
Ermittlung der Felsnachgiebigkeit für die Bemessung von Druck-
stollen und Druckstollenauskleidungen)

Principal data on many pressure tunnels and shafts in Europe, completed, under construction, or in planning, illustrate the trend to higher pressures (up to over 1800 psi (130 kg/cm^2). It has become necessary to utilize more and more of the support of the adjoining rock masses. Different methods for determining the deformability of in-situ rock, with principal technical data, are described in tabulated form. The method for pressure chamber tests as developed by Tiroler Wasser-kraftwerke AG is described in detail. This method utilizes a test chamber with an inside diameter of 7.3 ft (2.2 m) and a length of 6.7 ft (2.0 m). The pressure is applied by flat jacks supported by rings. Examples of stress-strain curves for phyllite before and after grouting are given. A graph for the design of tunnel linings with a 9.7-ft (2.90 m) inside diameter concludes the paper. Comprehensive references to European publications on the subject are given.

H. Lauffer   Vol. 25, No. 2/3, 1960, pp. 114 - 129

5.04 The Strength of Preconsolidated Soils (Die Festigkeit vorbelasteter Böden)

The shear strength of highly consolidated and layered tertiary marl, to be utilized for support of a hydropower plant in West Germany, was determined by large-scale in-situ testing. In earlier investigations direct-shear tests, with shear planes on the order of 14 square feet (1.3 m^2), were performed. More recent work included laboratory triaxial compression tests on samples 8 inches (20 cm) in diameter and 20 inches (50 cm) in height, and also in-situ double-shear tests on a circular block, 3 ft (90 cm) in diameter. The shear strength along bedding was determined to be c = 4.5 psi (0.32 kg/cm^2); ϕ = 30°; in an oblique direction to the bedding the shear strength was determined to be c = 36 psi (2.55 kg/cm^2); ϕ = 41°. Technical details of test arrangements and complete test results are given.

H. Breth   Vol. 25, No. 2/3, 1960, pp. 177 - 185

5.05 Evaluation of Statical Deformation Measurements in In-situ Rock (Auswertung von statischen Felsdehnungsmessungen)

Pressure-chamber tests and plate-load tests, to different scales, provide data on the deformability of in-situ rock. The stress-strain relations for elastic and elastoplastic rock masses are discussed; the moduli of deformation and elasticity are differentiated. A graphical method for design of linings of underground openings in rock subject to internal pressure is given. This method does not require the assumption of Poisson's

ratio. The stress distribution within rock masses adjoining openings subject to internal pressure is given for idealized rock and jointed rock under overburden pressure. The relations between moduli of deformation and elasticity, the radii of and pressures within pressure chambers are given for both elastic and elastoplastic rock masses. It is concluded that pressure-chamber tests should be conducted by applying pressures equal to those expected in the prototype. The paper presents comprehensive data and numerous stress diagrams.

G. Seeber   Vol. 26, No. 3, 1961, pp. 152 - 176

5.06 On the Poisson's Number of In-situ Rock Masses (Über die Querdehnungszahl des Gebirges)

Poisson's ratios of many rock types as determined by static and dynamic laboratory tests are given. The values range from 0.04 to 0.5. It is believed that, besides the petrofabrics of the rock substance and its anisotropy, the porosity is of considerable influence on Poisson's ratio. Poisson's ratio is illustrated in one example. At least in surficial, highly jointed rock this influence should not be disregarded. Formulae for determination of the modulus of elasticity by means of different types of tests are given. One- and two-dimensional stress-relief tests after Tincelin are discussed briefly. Comprehensive references to literature on the subject of elasticity of rock and rock masses are given. (Author uses Poisson's numbers.)

H. Link   Vol. 26, No. 4, 1961, pp. 246 - 257

5.07 Principal Considerations of Large-Scale Tests on Rock Masses (Grundsätzliches über gebirgstechnologische Grossversuche)

Rock mechanics principles are considered first. The difference between rock material, such as cores, and in-situ rock masses is stressed. The strengths of in-situ rock and its anisotropy depend primarily on the structure of the rock, and to a lesser extent on its substance. Since a test body has to include a statistically valid representation of the rock structure, rock tests are to be large-scale, and consequently in-situ tests. The stress distribution within layered material is inhomogeneous. Long duration tests and alternate load tests are important to provide valid results. The direction of testing has to be selected carefully, based upon statics and also rock mechanics considerations. The rock tests at the site of the Kurobe IV dam in Japan are briefly described.

L. Müller   Vol. 27, No. 1, 1961, pp. 1 - 8

5.08   Practice of Large-Scale Rock Tests (Die Praxis der Felsgross-
       versuche)

   Practical experiences obtained from conducting a comprehensive
   program of large-scale rock tests at the site of the Kurobe IV
   arch dam in Japan are presented. Principal types of rock tests
   as performed are described and illustrated. The problem of
   their execution, such as excavation, rock mechanics, load and
   measuring devices, is discussed. It is concluded that al-
   though large-scale rock tests are expensive, their results are
   very important for rock mechanics and design of dams.

   K. W. John   Vol. 27, No. 1, 1961, pp. 9 - 19

5.09   Instrumentation for Large-Scale Rock Tests (Instrumentation für
       Grossve suche in Fels)

   Large-scale rock tests, covering the wide range from plate-
   load tests to observation of the deformations of dam abut-
   ments, necessitate loading devices, instruments, and control
   devices. Loads up to 4400 short tons (4000 t) are applied
   by means of piston jacks or flat jacks. Piston or rotational
   pumps provide pressures up to 7000 psi (500 kg/cm^2), which
   is to accomplish high compressive stressing in test blocks.
   Displacements are preferably measured by inductive gages
   because they have larger measuring ranges than resistance
   methods. Different arrangements for measuring shear defor-
   mations in bore holes have been devised, based upon inductive-
   and resistance-measuring methods. Measurements are recorded
   automatically either continuously or in point-mode. For
   automatic and semi-automatic pressure regulating devices,
   standard components are combined to serve the particular
   needs.

   H. Steinbichler   Vol. 27, No. 1, 1961, pp. 20 - 28

5.10   On the Evaluation of Large-Scale Rock Tests (Zur Auswertung von
       Grossversuchen)

   The purpose of large-scale rock tests is to determine strength
   and deformability of in-situ rock for the stress conditions to
   be expected in a particular case. A combined approach by
   means of large-scale in-situ tests, model tests, photoelastic
   tests, and theoretical analysis is used to determine the tech-
   nical properties of in-situ rock. The state of stress and the
   anisotropy of the rock structure are important. The permissible
   stressing of a foundation rock is still to be defined; in most

cases it depends much more on the allowable deformation than on the ultimate strength of the rock.

F. Pacher   Vol. 27, No. 1, 1961, pp. 29 - 32

5.11 Stresses in the Earth's Crust as Determined by Hydraulic Fracturing Data

The knowledge of residual stress in rock masses is of great significance for engineering and geological purposes. The stresses adjacent to an oil well can be determined by means of hydraulic fracturing. It is assumed that fracturing of the material surrounding the well occurs through tensile failure under increased hydraulic pressure within the well. The pressure at which failure occurs depends on the residual stresses within the rock. The data from five wells are evaluated. Differences between principal stresses on the order of up to 2000 psi (140 kg/cm^2), which agree with the conditions as derived from seismic investigations, were determined. Equations are derived and limiting assumptions are stated. (Engl.)

A. E. Scheidegger   Vol. 27, No. 2, 1961, pp. 45 - 53

5.12 On Poisson's Ratios of Rock and In-situ Rock Masses (Zur Querdehnungszahl von Gestein und Gebirge)

Poisson's ratios of rock material as determined by static tests and by dynamic methods are compared. A considerable discrepancy is observed between the results of the different types of tests. Dynamic tests result in values of 0.25 to 0.33, with siliceous and porous materials as low as 0.10. Static tests often result in values less than 0.1, frequently as low as 0.04. A relationship between Poisson's ratio and confining pressure has been proved. The influence of loosening, jointing, and porosity is definitely confirmed. In-situ tests are discussed only briefly; Poisson's ratio on the order of 0.03 to 0.1 might be used for most in-situ rocks. Comprehensive data presented in the paper were obtained from international sources, particularly from the U.S. Bureau of Mines and the U.S. Bureau of Reclamation. (Paper gives Poisson's numbers instead of Poisson's ratios.)

H. Link   Vol. 27, No. 2, 1961, pp. 89 - 100

5.13 A Large-Scale In-situ Shear Test on Undisturbed Phyllite Rock
      (Ein Grosscherversuch in Phyllitgestein bei ungestörter Lagerung
      der Probekörper)

      The support of Pier I of the "Europe-Bridge" of the Brenner-
      Highway in Austria was to be supported on highly jointed
      quartz-phyllite. Several plate-load tests were performed in
      exploration tunnels and shafts. Soil mechanics tests were
      conducted on samples of the mylonitic joint fillers. The
      shear strengths along horizontal joint planes of the phyllite
      were determined by shear tests on rock blocks 3.3 ft by 3.3
      ft (1 x 1 m) in plan. The technical details of the test
      arrangements are described and illustrated. A sample of
      the stress-strain curves determined is given. A cohesion
      of 14 psi (1 kg/cm^2) and angles of internal friction of 20°
      to 37° were found for the joint planes.

      J. Malina   Vol. 27, No. 3/4, 1962, pp. 120 - 125

5.14 On the Difference Between the Moduli of Elasticity of Rock
      Material and Rock Masses as Determined by Static, Dynamic,
      and Seismic Methods (Über die Unterschiede statisch, dynamisch
      und seismisch ermittelter Elastizitätsmoduln von Gestein und
      Gebirge)

      The knowledge of the moduli of deformation and elasticity is
      essential for any design problem involving in-situ rock.
      Static determinations are expensive and time consuming, and
      result in extrapolations that may be doubtful. Dynamic
      methods allow determination of the data on elasticity of
      small samples such as drill cores. For rock, the dynamically
      determined values (usually) are higher than values determined
      by static methods. This is believed due to the different
      time rates of stressing. Seismic methods rapidly and cheaply
      provide average values on the modulus of elasticity over
      large areas; however, they do not give deformation moduli.
      Generally, seismically determined moduli of elasticity are
      three to twelve times higher than those determined by means
      of static pressure chamber tests. The paper presents com-
      prehensive comparative data based on international sources,
      particularly the U.S. Bureau of Mines and the U.S. Bureau
      of Reclamation. It also gives reference to international
      publications. (Paper gives Poisson's numbers instead of
      Poisson's ratios.)

      H. Link   Vol. 27, No. 3/4, 1962, pp. 131 - 145

5.15   Large-Scale Field Shear Box Tests on Quick Clay

In an investigation of a major landslide in Norway, the shear strength of quick clay in a drained condition was determined by means of in-situ shear tests. The clay layer, in which the slide took place, was exposed in the rear portion of the slide; it measured less than four inches in thickness. The technical details of two in-situ shear tests on 20 inch x 20 inch (50 x 50 cm) blocks and laboratory tests on 8 inch x 8 inch (20 x 20 cm) blocks are presented. Complete stress-strain curves are included. The angle of drained shear resistance was less than 9°. The theoretical implications of this type of test were discussed by L. Bjerrum, <u>Fifth International Conference on Soil Mechanics and Foundation Engineering, Paris, Proceedings</u>, Vol. 1, pp. 23 - 28. The paper gives valuable practical hints for performance of large-scale in-situ shear tests. (Engl.)

J. N. Hutchingson and
E. N. Rolfsen   Vol. 28, No. 1, 1962, pp. 31 - 42

6.   TUNNELS AND UNDERGROUND EXCAVATIONS

6.01   Engineering Geological Annotations on the Underground Excava-
tions in Austria During the Last Years (Baugeologische Rand-
bemerkungen zu den Hohlraumbauten der letzten Jahre in
Österreich)

J. Stini   Vol. 16, No. 1, 1946, pp. 1 - 45

6.02   The Influence of Surficial Impacts on Shallow Underground Exca-
vations in Granular Rock Masses (Der Einfluss obertägiger
Erschütterungen auf oberflächennahe Hohlräume in rolligem
Gebirge)

L. Hauser   Vol. 16, No. 3/4, 1948, pp. 86 - 91

6.03   The Upheave of the Floor During Construction of the New Semmering
Tunnel (Die Sohlenhebungen beim Bau des neuen Semmeringtunnel)

W. J. Schmidt   Vol. 20, No. 1, 1953, pp. 13 - 18

6.04   Geological Considerations on the Experiences Gained During Con-
struction of the New Semmering Tunnel (Geologische Gedanken zu
den Bauerfahrungen beim neuen Semmeringtunnel)

F. Kahler   Vol. 20, No. 3, 1953, pp. 129 - 132

6.05   Had the Construction of the Tunnel through the Karawanken Range
to be that Difficult? (Musste der Bau des Karawankentunnels so
schwierig sein?)

F. Kahler   Vol. 20, No. 3, 1953, pp. 198 - 211

6.06   Extensive Zones of Mylonite Impede Driving of the Förolach Erb
Tunnel (Lake Pressegg, Gail Valley) (Breite Mylonitzonen als
Vortriebshindernis am Beispiel des Förolacher Erbstollens
(Pressegger See, Gailtal)

F. Kahler   Vol. 21, No. 3, 1955, pp. 115 - 120

6.07 The Stressing of the Linings of Penstock Shafts in Anisotropic Rock Masses (Die Beanspruchung von Druckschachtpanzerungen im anisotropen Gebirge)

E. Tremmel   Vol. 23, No. 2, 1957, pp. 66 - 78

6.08 Seismic Vibrations in Rock Masses Adjoining Underground Powerhouse (Schwingungen im Untergrund eines Kavernenkrafthauses während eines Erdbebens)

Japan's first underground powerhouse was constructed in central Japan from 1952 to 1955. Its dimensions are 117 ft by 57 ft (35 x 17 m) in plan and 103 ft (31 m) high; the overburden depth ranges from 127 to 286 ft (38 - 86 m). It is located in coarse-grained granite. Previous observations indicate that the seismic intensities in tunnels are approximately half of those at the surface as long as the periods are less than one second. Periods on the order of four seconds resulted in equal intensities both at the surface and underground. Little damage due to earthquakes is generally observed in tunnels. Since the cavern was designed with a seismic acceleration factor of 0.12, a complete lining reinforced by rock bolts was believed necessary. After completion of the structure, an earthquake occurred which had an epicenter approximately 112 miles (180 km) from the site. The seismograms confirmed the intensities underground to be approximately one-half of those at the surface.

S. Okamoto and
T. Mizukoshi   Vol. 24, No. 2, 1958, pp. 113 - 117

6.09 Overbreak in Tunnels and Drifts (Der Mehrausbruch in Tunneln und Stollen)

In most construction jobs in rock, overbreak cannot be avoided completely; however, it can be reduced to a certain extent. Terminology and geometrical relations used in tunnel engineering are discussed in some detail. Unavoidable geological overbreak and avoidable overbreak are differentiated. The geological factors resulting in overbreak are reviewed, and the influence of the rock structure and the state of stress in the rock mass is emphasized. Technical factors, such as direction of tunnel, cross section, vibrations during construction, techniques of drilling and blasting, and temporary support, are discussed. Overbreak volumes can approximately be predicted based upon data on the rock structure. Recommendations on how to prepare definite specifications for

construction of tunnels are given. Comprehensive paper
based upon European conditions--of considerable practical
value.

L. Müller   Vol. 24, No. 3/4, 1959, pp. 204 - 222

6.10 Gastein and the Inrush of Warm Water into the Pressure Tunnel
of Lend (Gastein und der Warmwassereinbruch in den Lender
Druckstollen)

The construction of a pressure tunnel penetrating limestone,
located approximately 12 miles (20 km) from the thermal
springs of Badgastein, Austria, was not supposed to affect
the latter. The inrush of 160 GPS (620 l/sec) into the
tunnel during construction came as a surprise, and became
the subject of a comprehensive investigation. Geological
explorations of continuous fault zones and joints, and
hydrogeological and chemical studies proved that the warm
water flowing into the tunnel actually originated from the
same source as the thermal springs of Badgastein. Water
seepage from the pressure tunnel into the adjoining rock
might have a long-range effect on the thermal springs. The
positive seal of the lining of the pressure tunnel in the
zone of influx during construction was deemed advisable.

J. Stini   Vol. 24, No. 3/4, 1959, pp. 258 - 265

6.11 Survey of Tunnel Sections by Means of Intersecting Light Beams
(Lichtschnitt-Profilmessung in Stollen)

A simple apparatus for efficient and accurate surveying of
tunnel sections was developed in Austria. A projector
produces a disc of light which intersects the wall of the
underground opening. The resulting illuminated band repre-
senting a section is photographed, corrected for perspective,
and brought to the desired scale. The final tracing is re-
produced on translucent paper. The very precise results can
be utilized for differentiation between geological and
avoidable overbreak in construction of tunnels.

F. Koppenwallner   Vol. 25, No. 1, 1959, pp. 50 - 58

6.12 On the Evaluation of the Influence of Incomplete Transfer of
Tensile Stresses in Jointed Rock Masses on the Stressing of
Linings of Pressure Shafts (Zur Abschätzung des Einflusses der

unvollkommenen Zugspannungsübertragung im zerklüfteten Gebirge
auf die Beanspruchung von Druckschachtpanzerungen)

A modification of existing methods for the design of pressure
tunnels and their linings which considers the anisotropy of
the deformability of in-situ rock due to its structure is
proposed. The modulus of elasticity in the direction of
the maximum princi͟ stresses is assumed to be reduced in
order to allow the ͟͟plication of the theory of elasticity.
This paper presents complete formula͟ which allow immediate
applica͟icn.

E. Tremmͥ   Vol. 25, No. 2/3, 1960, pp. 228 - 232

6.13 An Unsuccessful Tunnel Heading (Ein gescheiterter Stollenvortrieb)

A detailed diary of an unsuccessful Austrian tunnel project
covering the period from 1924 to 1942 is given. A medium-
sized tunnel was planned to penetrate a massif consisting
of Triassic limestone with considerable Tertiary overburden.
Several attempts did not succeed in penetrat͟ng a complex
fault zone because of adverse water conditions which resulted
in temporary water influx of up to 53 GPS (200 1/sec). Safety
precautions prevented serious accidents. It is concluded that
the tunnel could have been completed if comprehensive drainage
measures had been taken.

F. Kahler   Vol. 25, No. 4, 1960, pp. 243 - 247

6.14 The Relation of the Geologist to New Methods of Tunnel Support
(Die Stellung des Geologen zu den neuen Methoden der Stollen-
sicherung)

Increased construction speed, new methods of support, and new
equipment have re͟ulted in new approaches to geological field
work. Many conventional methods of tunnel construction have
become outdated, and new methods with large tunnel sections
and large-scale blasting have been successfully introduced.
Gunite linings, with and without reinforcement, and rock
bolting, often combined with protective chain-link mesh,
serve as highly efficient temporary support. From a geo-
logical point of view it is desirable to minimize the time
period between initial excavation and installation of the
final lining. This paper essentially contains general
discussions.

F. Kahler   Vol. 26, No. 1, 1960, pp. 14 - 17

6.15 The Breaking of the Conduit Tunnel Caused by the Development of
the Gypsum Mine

> A pressure tunnel of a hydropower plant penetrating tuffaceous
> sandstone and shale was severely damaged by cracking of the
> concrete lining and settlements in the invert grade. A gypsum
> mine is located approximately 200 ft (60 m) below and 330 ft
> (100 m) in a horizontal direction from the tunnel. Initial
> investigations did not detect surface subsidence. Subsequent
> surveys, however, which were carried out over a one-year
> period, did show subsidence of the surface. The subsidence
> problem was analyzed utilizing the method by Bals (Germany)
> in which the amount of subsidence is expressed in terms of
> the height of the mine works. Coefficients of subsidence,
> of duration, and of extent are used. The results of the
> analyses correlated well with the measurements both in the
> tunnel and at the surface. Paper presents detailed observa-
> tion data. (Engl.)

H. Tanaka and
A. Kitano   Vol. 26, No. 1, 1960, pp. 18 - 32

6.16 Excavation of Highway Tunnels in Particularly Difficult Rock
Types (Ausbruch von Autobahntunneln in ganz besonders schwierigen
Bergarten)

> Along the route of the Autostrada del Sole in Italy, two
> highway tunnels were constructed in an old landslide area.
> Layered material consisting of plastic clays and sandstone
> was penetrated. To reduce the cross section of the tunnel,
> twin tunnels, each 33 ft (10 m) in inside diameter, were
> constructed. All tunnels were completely lined by concrete
> approximately three-ft (90 cm) thick. Initially, the multiple-
> drift (Austrian) method of tunnel construction was employed.
> For the second of the twin tunnels, the heading-bench method
> was used. In the latter method, temporary support was ob-
> tained by a layer of gunite applied immediately after excava-
> tion. A second layer was applied after steel ribs and chain-
> link wire were installed. The total thickness of the gunite
> liner ranged from 8 to 12 inches (20 - 30 cm). The latter
> method resulted in a 25% reduction of the thickness of the
> final lining.

A. Zanon   Vol. 26, No. 2, 1961, pp. 45 - 59

6.17 The Fractured Zone of the Kurobe Transportation Tunnel

The 2.8-mile-long (4.5 km) access tunnel to the site of
the Kurobe IV dam in Japan was constructed under considerable
difficulties. The tunnel penetrates fine- to coarse-grained
blocky biotite granite. After one mile, a fractured and
saturated fault zone was encountered, resulting in severe
deformation of timbering and influx of water (175 GPS, 660
l/sec). This zone, approximately 267 ft (80 m) wide, was
penetrated only after four drainage tunnels were constructed
parallel to the main tunnel. In addition, numerous drainage
borings were drilled in order to dewater the rock masses
adjoining the tunnels. Chemical grouting (Hydrock) was used
extensively for stabilization of the finely fractured rock
of the fault zone and for reduction of the water seepage.
The paper presents a detailed account of the construction
work. (Engl.)

K. Haga   Vol. 26, No. 2, 1961, pp. 60 - 78

6.18 Application of Microseismic Methods in Construction of Tunnels

(Application de la microsismique a la construction de galleries)

Microseismic tests in tunnels and other underground excavations,
before or after the lining is installed, provide information
on the properties of in-situ rock adjoining the openings. The
zone in which the stressing has been relieved because of over-
stressing and subsequent fracturing can be determined by con-
tinuous measurements of the dynamic modulus of elasticity and
Poisson's ratio. The results also assist in defining homo-
geneous zones adjoining the opening, which is important for
extending the results of other rock tests. The method sub-
stitutes technological measurements for empirical estimates.
The method described here has been applied at 187 underground
structures since 1955. (French)

M. F. Bollo   Vol. 26, No. 2, 1961, pp. 79 - 86

6.19 The Northern Portal of the Klammstein-Tunnel (Das Nordportal
des Klammstein-Tunnels)

The northern portal of the Klammstein-Tunnel near Badgastein,
Austria, was designed so that its statical function is ex-
pressed in its form. The portal partially cantilevers beyond
an almost vertical rock face into loose river deposits. Part
of the portal is founded directly on bedrock, and the outer-
most portion is supported by a concrete pedestal extending
to bedrock. The entire portal was to support heavily jointed
rock masses above. The horizontal thrust due to lateral

rock pressure is countered by horizontal, prestressed rock anchors. The architectural design resembles that of a shallow shell, arranged in an oblique angle to the axis of the highway and resting against the face of the rock massif.

L. Müller
F. Pacher   Vol. 26, No. 2, 1961, pp. 87 - 92

6.20 From the Practice of Tunnel Engineering, Some Experiences on

True Rock Pressure (Aus der Praxis des Tunnelbaues, einige

Erfahrungen über echten Gebirgsdruck)

In North Iran, the lining of a one-track railroad tunnel, which penetrated expansive phyllite, failed one and one-half years after completion. The tunnel had been completed only after considerable difficulties; construction was by the Belgium method. Considerable lateral deformations were experienced during construction. The concrete lining in the high pressure zone ranged from three to four feet (approximately 1 m) in thickness. Over a length of 667 ft (200 m), the lining roof was sheared off at the 11:00 o'clock and 1:00 o'clock points of the perimeter (12:00 o'clock would be the center of the roof arch). The failure occurred where the axis of the curved tunnel was about parallel to the vertical lamination of the rock. The mechanics of the shear failure and the resulting stresses are reconstructed. The destruction of a protective tunnel in clay by aerial bombing and the failure of a test adit in shale also are examined. An example is given of the difficulties of securing of gunite linings by rock bolting in soft, unstable rock.

L. Von Rabcewicz   Vol. 27, No. 3/4, 1962, pp. 153 - 167

7.   <u>DAMS AND ROCK ABUTMENTS</u>

7.01   Some Considerations on Modern Dam Construction in Smaller
       Countries (Einige Gedanken über den neuzeitlichen Talsperrenbau
       in kleineren Staaten)

       J. Stini   Vol. 17, No. 4, 1950, pp. 143 - 151

7.02   Statics and Dam Geology (Statik und Talsperrengeologie)

       J. Stini   Vol. 20, No. 2, 1953, pp. 88 - 110

7.03   Faults and Dam Construction (Verwerfungen und Talsperrenbau)

       J. Stini   Vol. 20, No. 3, 1953, pp. 152 - 166

7.04   The Securing of Dam Foundations (Die Baugrundsicherung von
       Stauanlagen (Talsperren))

       K. Keil   Vol. 22, No. 2, 1956, pp. 114 - 129

7.05   Faults and Dam Construction (Verwerfungen und Talsperrenbau)

       J. Stini   Vol. 23, No. 1, 1957, pp. 51 - 54

7.06   Influence of Large Differences in the Moduli of Elasticity of
       Concrete and Rock on Design of Arch Dams (Einfluss grosser
       Elastizitätsunterschiede zwischen Beton und Fels auf die
       Berechnung einer Sperre)

       O. Zerlauth   Vol. 23, No. 2, 1957, pp. 103 - 111

7.07   Some Practical Considerations of Foundation Problems of Arch Dams
       (Einige praktische Überlegungen zum Problem der Gründung von
       Staumauern)

          Dams and their foundations are believed to be an inseparable
          static unit. The design should attempt to minimize tensile
          stresses of the rock abutments. Rock anchoring should be used
          only as a last resort. Very narrow valley sections are apt

to be unfavorable dam sites. Their rock flanks are often subject to tension normal to slopes, resulting in jointing parallel to slope lines. Any dams, and particularly arch dams, can be designed to resist major earthquakes. The advantages of arch dams over gravity dams are emphasized, because of the higher strength and load-carrying capacity of the former. Discontinuities within dams, their bases, and their foundations should be avoided. Such singularities might cause stress peaks and overstressing. Irregularities of the morphology of the valley section and of the deformability of the foundation rock essentially can be cancelled by the system of circumferential joints and foundation pads (Italian pulvino). A pulvino also reduces the undesirable restraint of the dam by the rock foundation. It reduces the problems due to deformations caused by temperature changes. Local geological discontinuities such as joints and faults should be reinforced by doweling and anchoring. A brief review of problems related to design of earth and rock fill dams concludes the paper. Comprehensive treatise by one of Europe's outstanding designers of water-retaining structures.

C. Semenza   Vol. 24, No. 2, 1958, pp. 61 - 81

7.08 Examples on the Influence of the Anisotropy of In-situ Rock on

the Foundations of Arch Dams (Beispiele für den Einfluss der

Gebirgs-Anisotropie auf Talsperrengründungen)

Most in-situ rock masses represent discontinuous materials with inherent anisotropies of their vectorial properties and inhomogeneities of their scalar properties. Several examples are given to illustrate the effect of anisotropies in the rock abutments on the support of large arch dams. The structure of the rock mass and its orientation in respect to the dam thrust govern deformability, stress distribution, and the ultimate strength of a rock abutment. Photoelastic studies were used to investigate problems related to stress distribution in jointed rock; however, large-scale in-situ tests are necessary to determine the mechanical properties of jointed rock masses.

L. Müller   Vol. 24, No. 2, 1958, pp. 82 - 94

7.09 Brief Considerations on Rupture of Arch Dam Abutment

A series of two-dimensional model tests was performed on horizontal sections through the dam and rock abutments for the design of the Kurobe IV arch dam in Japan. The stress distribution, based upon assumed elastic behavior, was investigated for homogeneous and for jointed rock abutments.

The condition of failure was investigated for homogeneous weak rock and firm rock with jointing (1) parallel to the direction of thrust and (2) parallel and normal to this direction. For homogeneous abutments the theory of elasticity appears to be applicable. The quantitative evaluation of the tests on homogeneous abutments is difficult. The simulated anisotropies of the jointed rock abutments greatly affected the failure patterns. Failure patterns and deformations observed in this test series are presented. (Engl.)

M. Takano   Vol. 25, No. 2/3, 1960, pp. 130 - 141

7.10 Rupture Studies on Arch Dam Foundation by Means of Models

Three-dimensional model tests were carried out for the design of the Kurobe IV dam in Japan. They served to investigate the influence of the structure of the rock abutment on the stability of the arch dam. The model scale was 1 : 500. The highly jointed abutment rock was represented by several alternate model structures. Homogeneous rock was represented by a compacted mixture of sand and soluble glass. Jointed rock was represented by cubes of plaster separated by clay seams. Only hydrostatic loading was applied. The dam supported on homogeneous material failed by shear through the rock adjacent to the dam. The rupture commenced in the lower third of the contact. The abutment consisting of jointed material failed along joints parallel to the dam thrust. The failure was preceded by considerable deformation in the rock mass. In subsequent tests, the orientation of the joint system was modified in order to determine the orientation of least resistance. The comprehensive paper includes numerous illustrations. (Engl.)

M. Takano   Vol. 26, No. 3, 1961, pp. 99 - 121

7.11 Observation and Surveys on the Abutments of the Vaiont Dam

The Vaiont arch dam, 875 ft (262 m) high, is situated in a very narrow valley in the North Italian mountains. The abutment rock is composed of limestone which is jointed both parallel and normal to the slope surface. Rock tests were performed both in the laboratory and in-situ. The latter comprised seismic and static tests. Stress relief measurements, plate-load tests, pressure-chamber tests, and rock-shear tests were performed to determine the technological properties of the in-situ rock. The effect of excavation blasting was observed during construction. The efficiency of grouting operations was controlled by seismic surveys of the zones being grouted. The movements due to stress redistribution during excavation were observed by seismographs. In order to observe the

deformations of the rock abutments during filling of the reservoir, a comprehensive system of stress and deformation meters were installed. The latter consists of a combination of pendulums and extensometers. A geodetic net was instituted to coordinate all measurements. Piezometers are installed to control the efficiency of grout curtain and drainages. (Engl.)

M. Pancini   Vol. 26, No. 3, 1961, pp. 122 - 141

7.12 The Stress Distribution in the Rock Foundation of Concrete Dams

(Das Kräftespiel im Untergrund von Talsperren)

The increased size of dams and the necessity to utilize sites rejected earlier necessitate the improvement of knowledge on stress-strain relations in rock foundations. Of all exterior forces, the buoyancy and the thrust of the water contained in the joints are the most difficult to evaluate. A concept for this evaluation is given. The stress distribution in the rock abutment depends on the rock mass being utilized for support. Increasing rock volume results in steeper thrust lines which increase the stability of the abutment. Conversely, the buoyancy acting in the supporting rock mass raises the line of thrust. The stability of abutments consisting of jointed rock depends on both stress pattern resulting from overburden weight and on the dam thrust and its relative orientation to the structure of the rock mass. Stability analysis of rock abutments should be based on large-scale rock tests. It is concluded that at the present time the rock abutment represents the weakest part of most arch dams, with resulting true factors of safety of not much more than 1.5.

L. Müller   Vol. 26, No. 3, 1961, pp. 142 - 151

7.13 Results of the First Series of Tests Performed on a Model Reproducing the Actual Structure of the Abutment Rock of the Vaiont Dam

A comprehensive model test series for the final design of the Vaiont Dam was performed by I.S.M.E.S. in Bergamo, Italy. The Vaiont Dam is of the plunging arch type, 875 ft (262 m) high and 600 ft (180 m) wide at crest elevation. The dam is located in Northern Italy. The tests were performed on a 1 : 85 scale model of the dam supported on abutments which reproduced the structure of the actual in-situ rock. The model technique is described in detail and is well illustrated. The tests were performed successfully; however, the interpretation of the results proved rather difficult. The rock

abutments deformed somewhat, particularly in the middle
third of the dam height, but supported the dam satisfactorily,
even under a water head increased by 133 ft (40 m) above the
maximum reservoir level. (Engl.)

M. Pancini   Vol. 27, No. 3/4, 1962, pp. 105 - 119

8.   SLOPES AND LANDSLIDES

8.01 Landslides in the Region of Ernstbrunn-Dörfels, Lower Austria
(Erdrutschungen im Gebiete von Ernstbrunn-Dörfles, Niederös-
terreich)

F. Bachmayer   Vol. 17, No. 1, 1949, pp. 4 - 6

8.02 Newer Views on Ground Movements and their Control by the
Engineer (Neuere Ansichten über "Bodenbewegungen" und ihre
Beherrschung durch den Ingenieur)

J. Stini   Vol. 19, No. 1, 1952, pp. 31 - 54

8.03 New Facts and New Knowledge on the Rock Fall Region of Köfels
(Neuer Sachbestand und neue Erkenntnisse über das Bergsturzge-
biet von Köfels)

H. Ascher   Vol. 19, No. 2, 1952, pp. 128 - 134

8.04 Downhill Dipping Beds and Dam Construction (Talauswärtsfallende
Schichten und Talsperrenbau)

J. Stini   Vol. 19, No. 4, 1952, pp. 254 - 257

8.05 Directions for Methodic and Economic Restoration Following
Landslides (Richtlinien für eine zielgerechte und rationelle
Sanierung von Rutschungen)

S. L. Rintel   Vol. 20, No. 2, 1953, pp. 81 - 87

8.06 Formation of Ice in a Talus Slope (Über Eisbildung in einer
Schutthalde)

G. Mutschlechner   Vol. 20, No. 2, 1953, pp. 110 - 114

8.14 On the Creep Phenomena on Rock Slopes and Their Indications

(Einiges über Talzuschübe und deren Vorzeichnung)

Three case histories of land creeps in natural rock slopes observed in Austria are presented: (1) A large gneiss massif creeps in the direction of its steeply dipping foliation. The traces of the creep can be clearly observed where the highly fractured slip zone was penetrated by a railroad tunnel. From a technical point of view the creeping rock massif can be considered stable since the creep occurs over a long period of time. (2) During construction of a second tunnel in a sloping region composed of phyllitic rocks, a high inflow of water was observed at a highly mylonitized fault zone also exposed at the surface. This increase in permeability is explained by the renewed movements along the fault and the resulting loosening due to tilting of rock laminae towards the valley. (3) A prominent rock massif considered for support of an arch dam was found to be separated from the adjoining rock masses by two distinct joints, partially filled with broken rock; however, no indications of present movement were found. It is concluded that engineers have to accept as stable what geologists might consider to be in a state of geological creep. The evaluation of the influence of time should depend on the length of the time period being considered.

G. Horninger   Vol. 24, No. 1, 1958, pp. 37 - 45

8.15 The Use of Heavy Equipment on Steep Slopes Might be Dangerous

(Gefahren des Maschineneinsatzes in steilen Halden)

The difficulties encountered in using heavy earth-moving equipment at rather small but difficult construction jobs related to rock slopes are briefly discussed. Conditions of both safety and economy are to be met. This paper refers only to typical European construction methods in alpine countries.

F. Kahler   Vol. 25, No. 1, 1959, pp. 64 - 67

8.16 Decompressed and Altered Zones in Steep and High Slopes (Zones Décomprimées et Alterées des Versants à Forte Pente)

The effects of erosion and gravity forces on steep slopes and the possibilities of seismic and statical methods of investigation are discussed. For a sloping region two principal limits are given: (1) the boundary of the zone of recognizable superficial alteration and fracturing, and (2) the generally more shallow zone of decompression or relaxation.

In addition, zones of displaced materials, with both dis-
turbed and undisturbed rock structure, are differentiated
from the overall, stable rock mass. Microseismic refraction
measurements allow determination of the boundary between
sound, stressed rock masses, and altered, relaxed rock masses.
The extent of the different types of displaced materials also
can be determined by dynamic investigations. (French)

M. F. Bollo   Vol. 26, No. 4, 1961, pp. 234 - 245

8.17 Classification of Landslide Fissures (Klassifizierung der Erd-

rutschrisse)

Classification and mapping of fissures developed during land-
slides provide valuable assistance in analyzing the mechanics
of the slides. A classification of the fissures based on
the type of stressing which caused the deformations is pro-
posed. Both superficial and deep fissures are considered.
The direction of the vector of total deformation in respect
to the orientation of the fissure surface is the principal
criterion used for this classification. The geomorphology
of different types of superficial landslide fissures is dis-
cussed in detail. A graphical system for mapping landslide
fissures also is proposed. Illustrative diagrams and a table
for morphogenetic classification are given.

G. Ter-Stepanian   Vol. 28, No. 1, 1962, pp. 43 - 54

9.   ROCK BOLTING AND ROCK ANCHORS

9.01   Annotations on Analysis and Construction of Steel Anchors in
       Rock (Einige Bemerkungen zur Berechnung und Ausführung von
       Stahlverankerungen im Fels)

       S. Soretz   Vol. 21, No. 4, 1955, pp. 162 - 168

9.02   Trial Operations with Rock Bolt Support in Soft Coal Deep Mining
       (Betriebsversuche mit Ankerausbau im Braunkohlentiefbau)

       O. Fabricius   Vol. 23, No. 1, 1957, pp. 20 - 40

9.03   On the Analysis of Rock Anchorings, Anchored Retaining Walls,
       and Revetment Walls (Über die Berechnung von Felssicherungen,
       verankerten Stützmauern und Futtermauern)

       F. Pacher   Vol. 23, No. 1, 1957, pp. 41 - 50

9.04   An Example of a Rock Bolting Job (Beispiel einer Felsnagelung)

           At a gravity dam being built in Austria, in order to minimize
           the amount of excavation at one rock abutment without im-
           pairing construction safety, rock bolting was employed.
           Perfo-rock bolts 7/8 inch (22 mm) in diameter and 8 ft (2.5 m)
           long were installed in the rock mass above the crest of the
           dam being constructed. This anchorage was to secure a rock
           region separated from the abutment massif by distinct open
           joints striking parallel to the valley and dipping about 45
           degrees. The installation proved to be more economical than
           an increase in the excavation volume. Anchoring was not
           utilized for final support. Technical details are given.

       E. Neuhauser   Vol. 25, No. 1, 1959, pp. 59 - 63

10.   SOIL MECHANICS

10.01 The Liquid Strength of Clays (Die Zerfliessfestigkeit von Tonen)

       E. Winkler   Vol. 16, No. 3/4, 1948, pp. 162 - 172

10.02 On Impermeable Cores in Soil Masses, in Damming of Valleys, and
       their Significance for Construction of Dams (Über dichte Kerne
       in Lockermassen, als Talabschlüsse, und ihre Bedeutung für den
       Bau von Stauwerken)

       C. Veder   Vol. 17, No. 1, 1949, pp. 1 - 3

10.03 Do Surveys of Joints in Soil Masses Make Sense? (Haben Kluft-
       messungen in Lockermassen Sinn?)

       J. Stini   Vol. 18, No. 1, 1950, pp. 47 - 51

10.04 Information on the Analytical Determination of the Energy
       Necessary for Artificial Compaction of Soils in Cylindrical
       Molds (Mitteilungen über die rechnerische Ermittlung der
       Energiemenge für die künstliche Bodenverfestigung im zylindrischen
       Areal)

       E. E. Hensolt   Vol. 18, No. 3, 1951, pp. 143 - 173

10.05 A New Method to Determine the Pore Volume (Eine neue Methode zur
       Bestimmung des Porenvolumens)

       H. Häusler   .   Vol. 18, No. 3, 1951, pp. 174 - 176

10.06 On the Survey of Structures in Soil Masses (Über Gefügemessungen
       in Lockergesteinen)
       H. Ascher   Vol. 19, No. 2, 1952, pp. 69 - 76

10.07 Proof of Stress Distribution in Soil Masses (Nachweis der Span-
       nungsverteilung in Lockermassen)

       L. Müller   Vol. 19, No. 4, 1952, pp. 245 - 253

10.08 Annotations on Engineering Geological Investigations of Quick
Sand Strata (Einiges aus baugeologischen Untersuchungen von
Schwimmsandschichten)

E. Schröder   Vol. 20, No. 3, 1953, pp. 133 - 135

10.09 The Allowable Loading and the Allowable Stressing of Foundation
Soils (Die zulässige Belastung und die zulässige Beanspruchung
des Baugrundes)

K. Keil   Vol. 20, No. 3, 1953, pp. 191 - 197

10.10 Annotations on Damages Due to Frost and Thawing on the Roads of
the Hartberg District in Winter 1953/54 (Bemerkungen zu den
Frost- und Tauschäden der Strassen des Bezirkes Hartberg im
Winter 1953/54)

W. Brandl   Vol. 21, No. 1/2, 1954, pp. 44 - 47

10.11 Prevention and Repair of Frost Damage in Road Construction
(Verhütung und Beseitigung von Frostschäden beim Strassenbau)

K. Keil   Vol. 22, No. 1, 1956, pp. 28 - 43

10.12 Artificial Clay (Künstlicher Ton)

K. Keil   Vol. 22, No. 1, 1956, pp. 44 - 48

10.13 Geophysics in Road Construction, Part Seven--Internal Friction
(Bodenphysik im Fahrbahnbau, 7. Teil - Innere Reibung)

E. E. Hensolt   Vol. 22, No. 3, 1956, pp. 173 - 220

10.14 Geophysics in Road Construction, Part Eight--The Dynamic Evalua-
tion of the Soil Mechanics Test (Bodenphysik im Fahrbahnbau,
8. Teil - Die dynamische Deutbarkeit des bodenmechanischen
Versuches)

E. E. Hensolt   Vol. 23, No. 4, 1958, pp. 176 - 259

10.15 On the Stability of Clay Slurries (Über die Stabilität von Tonschlämmen)

Clay slurries are used for grouting purposes, as lubricants for caissons and similar works, and as drilling mud for rotary borings. The stability of the clay slurry suspension depends on the interparticle forces, which in turn depend on the electrolytical environment of the dispersing medium. A series of tests was performed to investigate the effect of different additives, their doses in respect to change in viscosity, and resulting increase in stability of different clay materials. Some test results are presented; however, no definite conclusions are given.

R. Jelinek and
H. L. Jessberger   Vol. 25, No. 1, 1959, pp. 68 - 82

10.16 Indiciation of Pending Failures in Gravel and Sand Pits (Anzeichen von Einsturzgefahren in Kies- und Sandgruben)

Failures of gravel or sand banks in quarries generally occur rapidly and without advance warning. In many cases scaling of slightly cemented sand layers was observed which might be interpreted as an indication of overstressing, and should be taken as a warning of an eminent failure.

F. Kahler   Vol. 25, No. 4, 1960, pp. 256 - 258

10.17 Genetics of Sediments and Measuring of Grain Properties (Sedimentgenetik und Messung von Korneigenschaften)

If use is made of the different grain parameters found in the mineralogical particles of sediments, information is provided not only on genetic conditions, but also on the geological history before sedimentation. The maximum dimensions of the grains and "relative breadth" are determined by different methods described in the paper. Test data on sands and their evaluation in respect to their genesis are given. Particular features of the test results can be used for correlation of geological formations.

T. Hagerman   Vol. 25, No. 4, 1960, pp. 259 - 267

10.18 The "Hydraton" Method (Das Hydratonverfahren)

The paper discusses the practical application of the "Hydraton" method invented by the author. Hydraton is a trade name

(in Germany) for in-situ clay treated with chemical additives (lime) for stabilizing purposes. Hydraton is mixed and installed similarly to concrete. Satisfying performances of past applications, particularly in construction of earth-fill dams, resulted in favorable code specifications. The permeability, potential alteration of the chemical additives, the resistance against chemical effects, surface erosion, possibility of cracking of Hydraton linings, thixotropy of Hydraton, and allowable gradient of flow within the material are discussed. A table presents complete design data for a channel lining composed of a Hydraton mixture.

K. Keil   Vol. 27, No. 2, 1961, pp. 54 - 72

10.19 Construction of Deep Foundation Excavation in Water-Bearing

Soils for the Powerhouse of a Low Pressure Hydropower Plant

at the Adige-River (Herstellung einer tiefen Baugrube im

wasserführenden Lockergestein zur Errichtung des Krafthauses

eines Niederdruckkraftwerkes an der Etsch)

The paper contains a brief account of the excavation for a hydropower plant in Northern Italy, in cohesionless gravel and sand with layers of loamy gravel 25,000 square feet (2300 m^2) in area and 58 ft (17.5 m) deep. The maximum water head during excavation was 52 ft (15.5 m). From several alternates, the installation of a continuous diaphragm consisting of precast concrete elements 15 ft (4.5 m) long, with joints sealed with bentonite was selected. The concrete elements were installed as excavation proceeded. Quick conditions in local sand pockets necessitated installation of filter wells in the deep part of the excavation. The total influx into the completed excavation is on the order of 27 GPS (100 1/sec).

C. Veder   Vol. 27, No. 2, 1961, pp. 77 - 81

10.20 On the Cohesion of Sand, Accidents in Sand Pits and Their

Prevention (Zur Kohäsion des Sandes, Unfälle und Unfallverhütung

in Sandgruben)

The cohesion of undisturbed deposits of sands and the stability of steep slopes in sand pits are important with respect to accident prevention in quarry operations. Because soil mechanics is based on ideal conditions, its application does not always satisfy practical needs. Apparent cohesion of in-situ sands is observed in many cases; it is due to shape, surface, and gradation of grains, moisture conditions, and cementation.

Therefore, when stressed, sand deposits can react as quasi-solids with true compressive strength. Relaxation under stress results in distinct jointing, and thus sand "blocks," which might be the cause of accidents. Engineering geological investigation assists in improving safety conditions in sand pits. Comprehensive reference to international geotechnical literature is made.

A. Kieslinger   Vol. 28, No. 1, 1962, pp. 1 - 30

11. GEOPHYSICS

11.01 Contributions on Geoelectrical Subsurface Investigations (Einiges über geoelektrische Baugrunduntersuchungen)

V. Fritsch   Vol. 17, No. 1, 1949, pp. 7 - 29

11.02 The Correlation of "Areal Plan" and Geoelectric in the Subsurface Diagram (Das Zusammenspiel von Arealplan und Geoelectrik im Untergrundmessbild)

E. E. Hensolt   Vol. 18, No. 4, 1951, pp. 207 - 227

11.03 Determination of Damages Caused by Impacts on Ground Surface and Structure (Die Bestimmung von Erschütterungsschäden infolge Stosswirkung auf Boden und Gebäude)

E. E. Hensolt   Vol. 19, No. 1, 1952, pp. 1 - 28

11.04 On Electrical Investigations of Borings (Über elektrische Bohrlochuntersuchungen)

H. Seelmeier   Vol. 20, No. 3, 1953, pp. 145 - 148

11.05 Geophysics in Road Construction--Part One - Introduction; Part Two - On the Economics of Geophysical Procedures for Geotechnical Furposes; Part Three - Evaluation of the Geomorphological Pattern and the Natural Movement cf Foundation Soils; Part Four - The Natural Movements of Foundation Soils (Bodenphysik im Fahrbahnbau--1. Teil - Einleitung; 2. Teil - Über die Wirtschaftlichkeit bodenphysikalischer Verfahren im Dienste der Baugrunduntersuchung; 3. Teil - Befund der Reliefsubstanz des Geländes und der natürlichen Baugrundbewegung; 4. Teil - Die natürliche Baugrundbewegung)

E. E. Hensolt   Vol. 21, No. 1/2, 1954, pp. 1 - 33

11.06 Geophysics in Road Construction--Part Five - Geophysical Consideration (Bodenphysik im Fahrbahnbau--5. Teil - Geophysikalische Behandlung)

E. E. Hensolt   Vol. 22, No. 1, 1956, pp. 1 - 27

11.07 Geophysics in Road Construction--Part Six - Geoelectric Plan (Bodenphysik im Fahrbahnbau--6. Teil - Geoelektrischer Plan)

E. E. Hensolt   Vol. 22, No. 2, 1956, pp. 74 - 113

11.08 Influence of Radiation Energy on Properties of Rock (Einfluss der Strahlungsenergie auf die Gesteinseigenschaften)

The rheological properties of rocks are determined by their present and past environments. The effect of thermal energy is well proven. The influence of radioactivity is also a very important factor. The influence of gamma and neutron radiation is investigated in laboratory tests. After rock salt is exposed to radiation, which results in discoloring of the crystals as observed in nature, its strength decreases and its deformability increases by 250 per cent. The resistivity also decreases markedly. Similar but lesser effects are observed in carbon minerals. The effect of these changes of technical properties on the in-situ stress conditions might allow the determination of the state of stress by means of radiation measurements.

R. Kvapil   Vol. 25, No. 2/3, 1960, pp. 142 - 147

11.09 The Physical Bases of the Freezing Method (Die physikalischen Grundlagen des Gefrierverfahrens)

The freezing method has been employed in shaft construction for the last 50 years. Better understanding and more economical methods now render the freezing method feasible for civil engineering projects. The physical bases of the method are reviewed; the conditions for static and flowing ground water are differentiated. Equations are given for the growth rate of frozen bodies, the influence of spacing of pipes, and for the temperature distribution in the direction of the cooling pipes. The equations provide the principal data for the design of a modern freezing system for underground excavations. The paper essentially represents a hydrodynamic and thermodynamic study. The investigations for flowing ground water conditions are not yet completed.

W. Ständer   Vol. 27, No. 3/4, 1962, pp. 168 - 188

12.   MISCELLANEOUS TITLES

12.01 Annotations on Dirt Roads as Such and on Dirt Road Projects
       in Europe (Einige Bemerkungen über die Erdstrasse und zu
       Erdstrassenbauten im europäischen Raum)

       L. Hauser   Vol. 16, No. 1, 1946, pp. 46 - 48

12.02 The Tensile Strength of Roots (Die Zugfestigkeit von Pflanzen-
       wurzeln)

       J. Stini   Vol. 16, No. 2, 1947, pp. 70 - 75

12.03 The Nature of Austrian Pozzolan and the Function of its Sulfur
       Trioxide in Mixtures of Pozzolan and Portland Cement (Die Natur
       des österreichischen Trass und die Funktion seines SO_3 in
       Trass-Portlandzementgemischen)

       O. W. Blümel   Vol. 19, No. 2, 1952, pp. 115 - 127

12.04 Principal Considerations on "Engineering Biology" (Grundsätzliches
       zur Ingenieurbiologie)

       G. E. Kielhauser   Vol. 20, No. 3, 1953, pp. 149 - 151

12.05 Culture, Protection of Nature, and Relation to Nature in Civil
       Engineering Construction (Kultur, Landschaftsschutz und Natur-
       verbundenheit im Tiefbau)

       V. Jurina   Vol. 21, No. 1/2, 1954, pp. 34 - 43

12.06 Grading Equipment and Road Construction in Mountainous Areas
       (Räumgerate und Wegebau im Gebirge)

       A. Hauser   Vol. 21, No. 1/2, 1954, pp. 48 - 50

12.07 "Engineering Biology" and Building Construction (Ingenieurbiologie
       und Hochbau)

       G. E. Kielhauser   Vol. 21, No. 3, 1955, pp. 121 - 122

12.08   Damages of Buildings by Heat Originating in Manure Piles
        (Bauwerksschäden durch Dungstätten als Wärmeherde)

        E. Schenk   Vol. 23, No. 3, 1957, pp. 131 - 138

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